09/673105
529 Rec'd PCT/PTO 10 OCT 2000

3/PRTS

CARRIER MEMBER FOR ELECTRONIC COMPONENTS

BACKGROUND

The invention is directed to a carrier member of ceramic for electronic components.

Carrier members for electronic components such as, for example, inductances, are often composed of ~~plastics~~. The advantages of plastic as material for the carrier member are low costs, easy workability and low weight. Thus, for example, inductive components for ISDN applications are produced in commercially standard formats in pin embodiment, SMD embodiment or in formats suitable for PCMCIA cards. Corresponding structures are known, for example, from the company publication, "ISDN-Bauelemente", of Vacuumschmelze GmbH, Hanau, 1996. Such carrier members comprise electrical terminals that, for example, can be connected to the interconnects of a motherboard by soldering.

During the course of continued technological development, it is mainly housing formats in SMD technique, which are surface-mountable, that are being recently utilized. For mounting the components on a motherboard surface, it is desirable that the surfaces or, respectively, electrical terminals of the component that come into contact with the motherboard lie as flat as possible on the planar motherboard surface. Advantages ~~derive~~ in SMD mounting technology when the planarity of the surfaces is as ~~great~~ as possible. With respect to the planarity, however, the aforementioned carrier members of plastic have disadvantages. When the metallic terminal pins are connected to the leads of an electronic component, for example by soldering, ~~a lessening of the planarity occurs in~~ the region of the pins due to the heating during soldering. Further, a swelling of the housing due to heating of the entire housing also occasionally occurs during the subsequent soldering onto the motherboard.

[illegible] during the equipping of the motherboard.

Carrier members of ceramic are known from the informational publication, "Keramische Werkstoffe für die Electronik", Informationszentrum Technische Keramik, Selb, 1996. The described ceramic materials of aluminum

oxide or aluminum nitride are utilized as substrates for electronic circuits and as housing for semiconductor circuits or thyristors and diodes. The described housings are ~~a matter of~~ dual in-line housings (DIL) or chip carriers for surface mounting according to the SMD technique.

Ceramic carrier members for electrical coils are known from a company brochure of CeramTec, Marktredwiz, 1996. These carrier members are ~~a matter of~~ bridge-forming elements that surround the inductive component. The leads of the inductive component such as, for example, the leads of a coil located in the inside of the carrier member can only be joined to the metallized surfaces of the bridge-forming carrier at that plane of the carrier member facing toward the motherboard material. To this end, surface elements that are metal-coated sector-by-sector are located on this plande [sic]. The connection of the leads to the metal-coated surfaces thus ensues in the regions of the solder points.

The demands made of a carrier member for electronic components given SMD technique can be only inadequately met with the above-described embodiments. The ~~traditionall~~y designed carrier members are not always up to the demands, particularly in view of the planarity of the metallic surfaces of the ceramic carrier member facing toward the motherboard material. An optimally low fluctuation in the planarity of the components in the region of the metallic surfaces is therefore advantageous for utilizing the advantages of SMD mounting technology.

InsA32 An object of the present invention is to ~~offer~~ a carrier member that does not exhibit the aforementioned disadvantages of known carrier members.

The inventive object is achieved by a carrier member composed of a ceramic for electronic components having at least two contact surfaces 2 electrically insulated from one another, with ~~whereby~~ the contact surfaces being ~~are~~ arranged on a common plane of the carrier member, t~~his being characterized in that~~ further metallized [illegible] proceed parallel to the common plane of the contact surfaces 2, ~~whereby~~ a respective metallized surfaces being ~~surface is~~ conductively connected to ~~one of~~ the contact surfaces 2.

The ~~What are understood under the~~ term "contact surfaces" ~~according to the invention are~~ metallized surface layers that are located on the surface of the carrier

member and that are provided for joining the carrier member to the motherboard material. The contact surfaces are therefore arranged plane-parallel to one another. The shape of the contact surfaces is arbitrary. Dependent on the desired demand, for example, they can be square, rectangular, round or also n-polygonal. Different shapes of contact surfaces on one carrier member are also conceivable.

A The width of the contact surfaces ~~2~~ preferably lies in the range from 0.1 through 5 mm. A range from 0.5 through 10 mm is preferred for the length of the contact surfaces.

The common plane on which the contact surfaces are located usually corresponds to the underside of the carrier member, i.e. the side facing toward the motherboard material.

The metallized layers located on the carrier member in the region of the A contact surfaces ~~3~~ of the metallized surfaces ~~3~~ are essentially composed of a conductive material such as, for example, Cu, Ni, Au, C, W, Pt, Ag etc. It is possible that the manufacture of this coating ensues such that one or more intermediate layers are first applied and the conductive, metallized layer is applied as last layer. Suitable methods for coating ceramic materials with conductive layers are notoriously known. The thickness of the metallized layer preferably lies in a range from 0.1 through 40 μm.

The carrier member preferably comprises a ~~roof element 13~~ having an A inductive component ~~17~~ arranged on the inside surface of the ~~roof element 11.~~ A ~~However, it is just as possible that~~ the component is secured to some other surface of the carrier member, for example to a wall.

The geometrical shape of the inventive carrier member must be selected A such that the metallized surfaces ~~3~~ do not lie in the region of the contact surfaces ~~2~~. The surfaces that do not proceed parallel to the common plane of the contact surfaces [illegible] which the metallized surfaces [illegible] are located therefore preferably proceed at an angle of 90° relative to the common plane of the contact surfaces 2.

The inventive carrier member preferably comprises two ~~walls 12~~ A proceeding at an angle of 90° relative to the common plane of the contact surfaces ~~2~~, a ~~roof element 13~~ that is arranged perpendicular to the walls and parallel to the

common plane of the contact surfaces 2, and two end faces 5 that are arranged perpendicular to the ~~roof element~~ base and to the ~~walls~~ side walls. An example of a geometrical shape of this type is a cuboid open at one side having rectangular surfaces that has the shape of a shoe box.

Channel-shaped depressions 4 that, for example, can be introduced into the ceramic material by grinding, sawing or milling are preferably located between the metallized contact surfaces 2 and the metallized surfaces 3. These channel-like depressions are not metallized. It is also possible that the formed member already comprises corresponding, channel-shaped depressions in the manufacture, for example following a standard ceramic manufacturing method after the burning. The spacing of the channel-shaped depressions preferably lies in a range between 0.2 and 5 mm.

Channel-shaped depressions 4 are preferably arranged on the common plane of the contact surfaces 2 and further channel-shaped depressions 4 are arranged on the surfaces that do not proceed parallel to the common plane of the contact surfaces. These channel-shaped depressions 4 arranged on different planes form channel edges 15 in the region of the edges.

When a lead 7 of, for example, a coil is to be connected to the inventive carrier member, then this lead 7 is preferably electrically conductively connected to a metallized surface 3.

~~Said~~ lead is expediently conducted such through the channel edge 7 that the wire experiences a mechanical localization in the channel edges 15. This measure relieves a potentially existing contact and protects the wire against slipping.

The lead 7 guided by the channel edge 15 is preferably conductively connected to a metallized surface 3 immediately adjacent to the corresponding, channel-shaped depression

[illegible] contact surfaces [illegible] the inventive carrier member are [illegible] precisely manufactured and therefore exhibit high planarity. The ~~co-planarity of the plano-parallel~~ contact surfaces 2, defined according to the method described above, preferably ~~contributes less~~ deviate from than 30 um.

When the carrier member comprises a base ~~roof element 13~~ proceeding parallel to the common plane of the contact surfaces ~~2~~, then a fastening means can be present at the inside surface of the base ~~roof element 11~~ in the direction of the interior ~~6~~. The fastening means can, for example, serve for fastening a coil. The fastening means is preferably ~~a matter of~~ a conical frustum ~~10~~.

A core ~~9~~ with a winding ~~14~~ is preferably arranged at the ~~said~~ inside surface of the base ~~roof element 11~~.

~~The inductive component (17) is also expediently secured to the inside~~ surface of the upper side, for example with a standard adhesive. It is especially preferred when the interior is cast out with the adhesive.

No leads for electrical components are preferably attached or contacted at the contact surfaces ~~(2)~~ arranged at the underside of the carrier member. When a lead is joined to the carrier member according to the invention, the connection to the conductive surfaces ensues via the metallized surfaces ~~(3)~~ located, for example, at the side of the component.

The definition of the co-planarity ensues according to a laser distance measuring method. According to this method, the heights of the metallized surfaces facing toward the motherboard material are defined in a direction perpendicular to the common plane of the contact surfaces (Z-direction). One thereby proceeds such that the measured values of the height in Z-direction are determined in defined spacings from the leading edge of the carrier member. A compensation plane according to Gauss is calculated from these Z-measured values. The co-planarity is the sum of the amounts of the maximum and the minimum deviation of these values from the calculated, average compensation plane.

The inventive carrier members preferably comprise a co-planarity of less than 100 µm, particularly less than 50 µm. It is quite particularly preferred when the co-planarity lies below [illegible].

The present invention is also directed to an electronic component that contains an inventive carrier member. This component is characterized in that an electronic component such as, for example, a wound core is present in the carrier member.

The invention is also directed to the employment of the inventive carrier member for inductive components such as, for example, interface repeaters, interface modules, current-compensated inductors, power transformers, drive transformers for transistors, storage and filter inductors, transductor chokes, current transformers, current sensors, voltage transformers, drive repeaters for GTO/IGBT/SIPMOS, trigger transmitters and modules for thyristors or filter and smoothing inductors.

The inventive inductive component can be manufactured according to the following method that is likewise a subject matter of the present invention. The inventive method comprises the steps:

- fastening an inductive component 17 to the inside surface of a carrier member ~~according to claim 1~~;
- guiding the wires ~~7~~ of the inductive component via t~~he channel edges 15;~~
- guiding the wires ~~7~~ at an angle over the contact surface 4;
- contacting the wire 7 to the metallized surface 3 and, ~~potentially~~, r~~emoval of~~ the wire ends ~~7~~ projecting beyond the contact surfaces ~~8~~.

<u>Example</u>

Measurement of the co-planarity at 50 carrier members according to the invention.

The co-planarity was defined according to the above-described method at 50 carrier members having ~~respectively having~~ eight metallized surfaces according to the invention. All carrier members exhibited a co-planarity of less than 14 μm. Additionally, a data set was formed from the individual measured values of the spacings of the individual contact surfaces from the averaged compensation plane (Z-measured values). The plurality of measured values amounted to 8 x 50 = 400. The frequency distribution of these measured individual spacings from the compensation planes corresponded to a Gaussian distribution. The standard deviation of the [illegible]

The present invention is now explained in greater detail on the basis of Figures 1 through 3.

Figure 1 shows an inventive carrier member in a schematic illustration.

InsA67

Figure 2 shows the carrier member of Figure 1 in a view from above. The surfaces facing toward the motherboard material are located at the underside.

Figure 3 shows the inventive carrier member of Figure 1 from the side. Additionally, contacted and non-contacted wires are entered together with the carrier member.

The ceramic carrier 1 in Figure 1 is fashioned cuboid and ~~comprises~~ four lateral surfaces and one surface forming a ~~roof~~. The ceramic material can, for example, be aluminum oxide or aluminum nitride. Surfaces 2 arranged raster-like are located on the plane facing toward the motherboard material. The surfaces 2 are metallically coated. Channels 4 that represent depressions that, for example, can be introduced into the wall by milling or grinding are located between the surfaces 2 arranged segment-by-segment. The channels 4 continue upwardly beyond the lateral walls. Metallized surfaces 3 are located between the channels situated on the lateral wall. The metallized surfaces 3 are electrically conductively connected to the contact surfaces 2. The metallic layers can be applied onto the ceramic carrier member in the way standard in the prior art. The plan view in Figure 2 shows the channels 4 and the lateral, metallized surfaces 3. A lacquered copper wire 7 that is connected to the inductive component part (not shown) is shown within the channels 4.

The side view of the inventive carrier member in Figure 3 shows how the lacquered copper wires proceed via the channel edge 15. The wire 7 is drawn around the channel edge 15 and proceeds at an angle 16 of more than 0° and less than 90° relative to the longitudinal axis of the metallized surfaces, proceeding over the metallized surfaces. The ceramic carrier 1 enables a machine contacting of the wires 7 to the contact surfaces 2 in an especially simple way. In this method, the wires 7 that can be connected to an inductance are first conducted over the channel edges 15 and are guided parallel to the lateral surface of the ceramic carrier at said angle 16 [illegible] region of the metallized surface 3. The projecting wire ends are either removed or are automatically cut off upon contacting. As a result thereof, it is possible to reduce the mechanical stressing of the contacts 8. The guidance of the wire in channels 4 or.

~~respectively~~, over channel edges 15 contributes to a mechanical fixing of the wire 7. The contacting can, for example, ensue by welding.

Figure 4 shows a further embodiment of an inventive carrier member without end walls 5. A ~~worked in~~ cone that is composed of the same material as the carrier is located at the inside surface of the upper side of the carrier member. An annular magnetic core 9 is plugged onto the cone 10, this being potentially secured, for example, with a standard adhesive compound. The connections of the lining 14 to the leads 7 are conducted via the channel edges 15 and end at the contacts 8.

Compared to carrier members of plastic, ceramic carrier members have the advantage of a far higher temperature resistance and a reduced sensitivity to moisture.

The local-planarality of the inventive carrier member - given mounting on a motherboard - provides the electronic component part with an improved wettability of the metallized terminal surfaces. As a result ~~thereof~~, the layer thickness of the solder material that is utilized can be reduced and the processibility of, in particular, components having a small grid dimension, such as preferably less than approximately 0.2 mm, especially preferably less than 0.13 mm, can be significantly facilitated.

Another advantage of the inventive carrier member over known carrier members is that the guidance of the leads of a component in the channel edges (15) effects a mechanical fastening of the wire that proceeds beyond the standard fastening at the contact location. As a result of this measure, a nearly complete mechanical relieving of the electrical contact can be achieved accompanied by a far, far lower frequency of damage in the region of the contact.